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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/945,065	08/30/2001	Ammar Deraa	MICRON.172A	3019

20995 7590 01/28/2008
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EXAMINER

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ART UNIT	PAPER NUMBER
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2811

NOTIFICATION DATE	DELIVERY MODE
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01/28/2008

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte AMMAR DERAA,
SUJIT SHARAN, and
PAUL CASTROVILLO

Appeal 2007-3277
Application 09/945,065
Technology Center 2800

Decided: January 24, 2008

Before EDWARD C. KIMLIN, BRADLEY R. GARRIS and
PETER F. KRATZ, *Administrative Patent Judges*.

KRATZ, *Administrative Patent Judge*.

DECISION ON APPEAL

1 This is a decision on an appeal from the Examiner's final rejection of claims 1-4 and 6-20, the only claims that remain pending in this application. We have jurisdiction pursuant to 35 U.S.C. § 6.

Appellants' invention is directed to an integrated circuit comprising a silicon substrate, an insulating layer located thereon, and a metal layer formed in an opening that extends through the insulating layer. A portion of the metal layer contacts the substrate surface and forms a metal silicide by reaction with substrate silicon. Another portion of a metal layer does not contact the substrate surface and undergoes no reaction with the substrate silicon. A metal silicide layer is formed on an upper surface of the metal layer; that is, at least a portion of the metal layer which is not in contact with the substrate surface, such that the latter silicide layer can function as an adhesion layer located between non-reacted metal and a subsequently formed metal nitride layer. Claim 1 is illustrative and reproduced below:

1. An integrated circuit comprising:

a silicon substrate;

an insulating layer formed on the silicon substrate wherein the insulating layer has an opening that extends from an upper surface of the insulating layer to an upper surface of the substrate so as to expose the upper surface of the substrate;

a metal layer formed in the opening wherein a first portion of the metal layer is formed on the exposed upper surface of the substrate and reacts with silicon in the substrate to form metal silicide, wherein a second portion of the metal layer does not contact the substrate and remains unreacted; and

a metal silicide adhesion layer formed on an upper surface of the second portion of the metal layer, wherein the metal silicide adhesion layer adheres the second portion of the

metal layer to a metal nitride layer that is subsequently formed on the first and second portions of the metal layer.

The Examiner relies on the following prior art references as evidence in rejecting the appealed claims:

Thakur	6,262,485 B1	Jul. 17, 2001
Dixit	6,355,558 B1	Mar. 12, 2002
Taguwa	6,404,058 B1	Jun. 11, 2002

Claims 1-4, 6, 7, 9-14, and 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Taguwa in view of Thakur. Claims 8 and 15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Taguwa in view of Thakur and Dixit.

We affirm both rejections. Our reasoning follows.

Appellants assert that the rejected claims do not all stand or fall together and furnishes two groupings of claims: Group I, which includes claims 1 and 7-9, and Group II, which includes the remaining appealed claims (Br. 3). However, Appellants do not furnish separate arguments for each of the claims subject to each separate obviousness ground of rejection and/or within each claim grouping.¹ In this regard, a recitation as to what a particular claim is alleged to require as a limitation does not, of itself, amount to a separate argument for the patentability of that claim.

§ 103(a) Rejection over Taguwa and Thakur

¹ See 37 C.F.R. § 1.192(c)(7) (2003) and *In re McDaniel*, 293 F.3d 1379, 1383 (Fed. Cir. 2002) (“if the brief fails to meet either requirement, the Board is free to select a single claim from each group of claims subject to a common ground of rejection as representative of all claims in that group and to decide the appeal of that rejection based solely on the selected representative claim”). In this regard, we note that the Appeal Brief was filed October 23, 2003. A claims Appendix was submitted March 17, 2005.

We select claim 1 (Group I) as the representative claim for all of the so rejected claims. In this regard, we note that the second claim grouping includes dependent claim 2, which claim merely adds the requirement for a titanium metal layer, a feature not separately argued in the Appeal Brief and/or the Reply Brief.² As such, we shall confine our discussion primarily to rejected claim 1 for the first stated rejection.

The Examiner has found that Taguwa discloses an integrated circuit including a silicon substrate and an insulating layer with a metal (titanium) layer formed in an opening thereof wherein a portion of the metal layer contacts the substrate (Ans. 3-4). The Examiner has also determined that Taguwa discloses the formation of a metal silicide (titanium silicide) layer on the metal layer thereof and the subsequent formation of a metal nitride (titanium nitride) layer on the latter silicide layer (Ans. 4). Appellants do not specifically contest these determinations of the Examiner. Thus, the Examiner has fairly determined that the circuit device of Taguwa substantially corresponds to the requirements of representative claim 1 but for explicitly describing that a portion of the metal layer formed in the insulating layer opening that contacts the silicon substrate reacts to form metal silicide.³

The Examiner turns to Thakur to show an integrated circuit device with a contact opening through an insulation layer wherein metal silicide

² Our references to the Appeal Brief are to the Brief filed as noted in footnote 1 above. Our references to the Reply Brief are to the Reply Brief filed September 02, 2004 (Certificate of Mailing dated August 30, 2004). We note that the subsequent Reply Brief received on May 03, 2007 is indicated by Appellants as being identical in content to the September 02, 2004 filed Reply Brief.

³ Of course, a product integrated circuit, not a method is being claimed.

(titanium silicide) is formed via the reaction or annealing of a deposited metal (titanium) with the silicon of the substrate (Ans. 4). The Examiner notes that such silicide formation decreases the ohmic resistance of a contact interconnection as taught by Thakur (*id.*; Thakur, col. 3, ll. 62-64). Based on the combined teachings of Thakur and Taguwa, the Examiner takes the position that forming silicide in Taguwa in the vicinity where the substrate and deposited metal layer meet would have been obvious to one of ordinary skill in the art at the time of the invention (Ans. 4). According to the Examiner, this is so because an ordinarily skilled artisan would have sought to secure the decreased resistance advantage for the contact being formed by Taguwa via such silicide formation, as disclosed by Thakur (*id.*). We agree. Indeed, Appellants acknowledge that such metal silicide formation is known to form low resistance electrical contacts (Specification 1-2).⁴

Moreover, silicide formation in the region of the metal layer and the substrate interface in Taguwa would not only have been obvious for the reasons expressed by the Examiner but such silicide formation by reaction of the substrate silicon and deposited titanium would have been reasonably expected to obviously or intrinsically occur as a result of the titanium metal deposit in Taguwa, particularly where the titanium metal is deposited at

⁴ It is axiomatic that admitted prior art in an Applicants' Specification may be used in determining the patentability of a claimed invention and that consideration of the prior art cited by the Examiner may include consideration of the admitted prior art found in an Applicants' Specification. *In re Nomiya*, 509 F.2d 566, 570-571 (CCPA 1975); *In re Davis*, 305 F.2d 501, 503 (CCPA 1962). Also, see *In re Hellsund*, 474 F.2d 1307, 1311 (CCPA 1973). Note also *In re Fout*, 675 F.2d 297, 301, (CCPA 1982), “[i]t is not unfair or contrary to the policy of the patent system that appellants’ invention be judged on obviousness against their actual contribution to the art” (footnote omitted).

temperatures greater than 500°C, which is disclosed by Taguwa as an option. Compare the titanium deposition conditions disclosed by Taguwa with the silicide formation conditions disclosed by Thakur (Taguwa, col. 4, l. 65 – col. 5, l. 17; Thakur, col. 4, ll. 46-53). After all, representative claim 1 does not require any particular degree or amount of silicide formation resulting from reaction of the silicon of the substrate with the deposited titanium so long as at least some silicide formation at the substrate/titanium interface occurs.

In light of the above and for the reasons stated in the Answer, Appellants' contention that there is no suggestion in the applied references for the Examiner's proposed combination and/or the formation of metal silicide at the metal/substrate vicinity of Taguwa's integrated circuit device is not persuasive. Moreover, Appellants' assertions about the titanium silicide layers of Taguwa that do not contact the substrate as lacking a contact improvement function are patently unpersuasive in that representative claim 1 does not require such a function for a metal silicide layer formed on the upper surface of a portion of the metal layer (Reply Br. 2). In this regard, Appellants' arguments in the Appeal Brief and the Reply Brief with respect to a dual function (adhesion and contact improvement (refractory metal)) for a metal silicide layer that is allegedly lacking in the applied references are not persuasive. In particular, we note that the contact improvement function would have been expected with silicide formation at the substrate surface region as taught by Thakur and acknowledged by Appellants in their Specification, as discussed above. As for the argued adhesion function, Taguwa reasonably suggests that the metal silicide will furnish such a benefit when used as an interlayer between a subsequently

formed nitride layer and a metal layer, as noted by the Examiner (Ans. 8, Taguwa, col. 3, ll. 24-50). Further concerning this matter, we again note that representative claim 1 does not require any particular amount of silicide formation via reaction between the substrate silicon and deposited metal so as to yield any particular degree of contact improvement for the claimed device. Nor does representative claim 1 require any particular degree of adhesion improvement based on the formed silicide layer that would serve to patentably distinguish the claimed subject matter over the silicide layer of the integrated circuit of Taguwa, as pointed out by the Examiner (Ans. 8).

On this record, we affirm the Examiner's rejection of claims 1-4, 6, 7, 9-14, and 16-20 as being obvious, within the meaning of 35 U.S.C. § 103(a), over the combined teachings of Taguwa and Thakur.

§ 103(a) Rejection over Taguwa, Thakur, and Dixit

Appellants do not separately argue the Examiner's additional application of Dixit to dependent claims 8 and 15 in this rejection. Accordingly, on this record, we shall also sustain the Examiner's separate rejection of these dependent claims.

CONCLUSION

The decision of the Examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

AFFIRMED

Appeal 2007-3277
Application 09/945,065

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